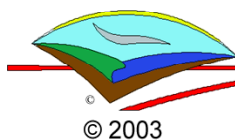
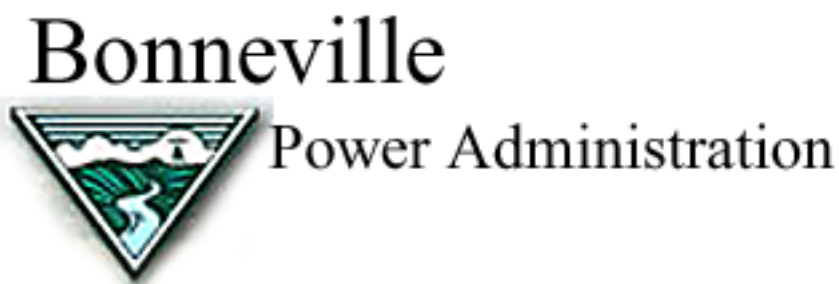

Satellite and Aerial Imagery Demonstration Project

USGS Topographic Digital Raster Graphics (DRG)



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September 2003

**WHY
TOPOGRAPHIC
DRGS?**

Digital topographic maps, also known as Digital Raster Graphics (DRG's) are an accessible and useful source of geospatial data of the land surface. Topographic maps are created for a variety of purposes and range from very large scale maps (1 inch = 100 feet or larger) produced by municipalities and transportation departments to very small scale (1:250,000) regional topographic maps produced by the U.S. Geological Survey (USGS). All topographic maps represent spatial variation of elevation of the ground surface. Beyond that, depending on purpose, topographic maps depict specific features on or related to the ground surface. Features may include land cover type, hydrography (streams and waterbodies), building locations, cultural features, political boundaries, road systems, railroads, pipelines, and transmission lines. Topographic maps usually incorporate coordinate grids and scale bars to find geographic locations determine the size of surface features in real world dimensions. USGS topographic maps display multiple coordinate grids including latitude and longitude (geodetic), U.S. customary (State Plane) and metric coordinate systems (UTM). Digital topographic maps are useful as initial base map coverages for GIS projects.

OBJECTIVE

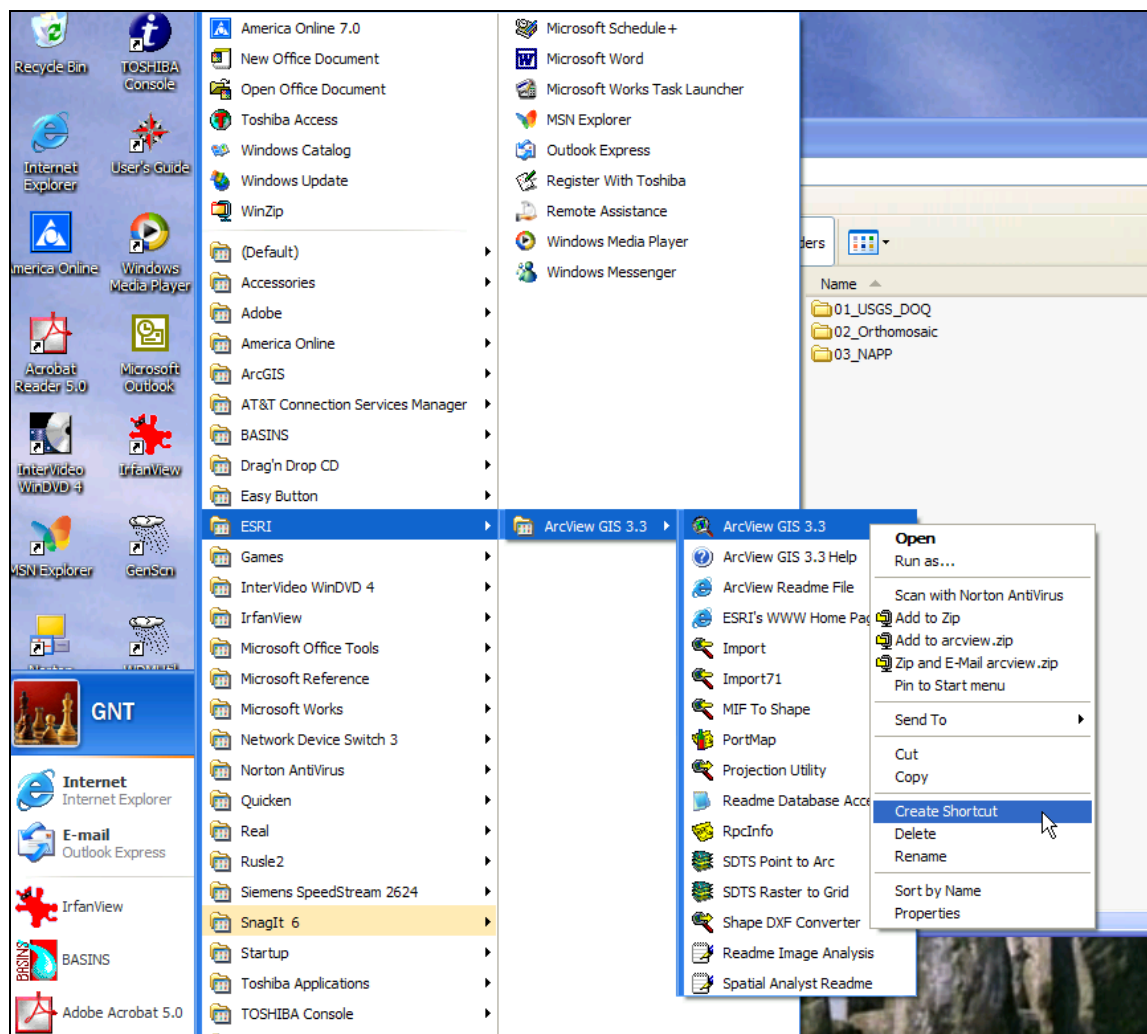
This tutorial will guide the creation of a basic ArcView 3.3 project and introduce the three most common scales of DRG's produced by USGS: the 1:250,000 (250K), 1:100,000 (100K), and the 1:24,000 (24K) DRG's. DRG's used in this tutorial are of the area near Walla Walla and College Place, WA. We will use ArcView's GIS tools to compare the content spatial characteristics of the various DRG's.

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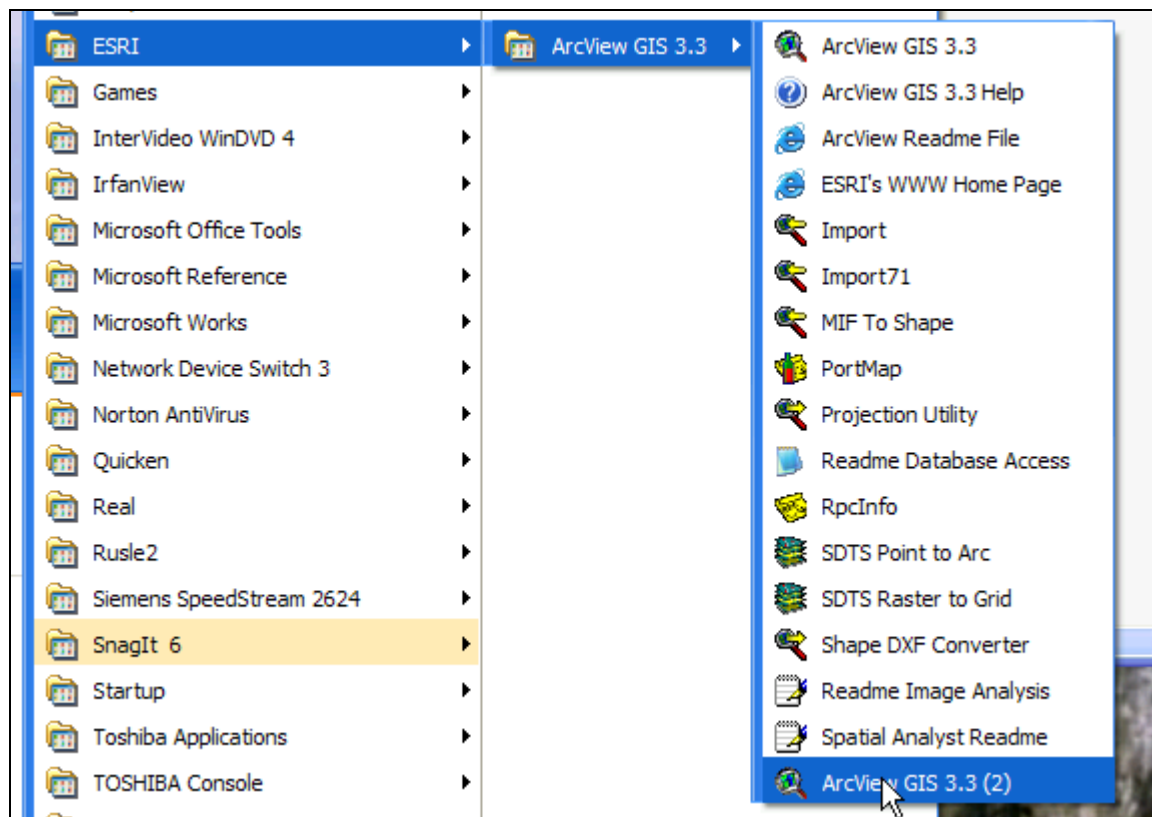
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1. Create an ArcView Desktop Shortcut

Open the Start All Programs menu. Move the mouse pointer to the ESRI:ArcView GIS 3.3:ArcView GIS 3.3. Click and hold the right mouse button. Drag the pointer down to Create Shortcut. Release the right mouse button.



Reopen the ArcView GIS 3.3 start menu. A new item ArcView GIS 3.3 (2) should have been created. Place the pointer on the new entry, press and hold the left mouse pointer, then drag the shortcut icon on the desktop. Place the shortcut icon in a convenient location.

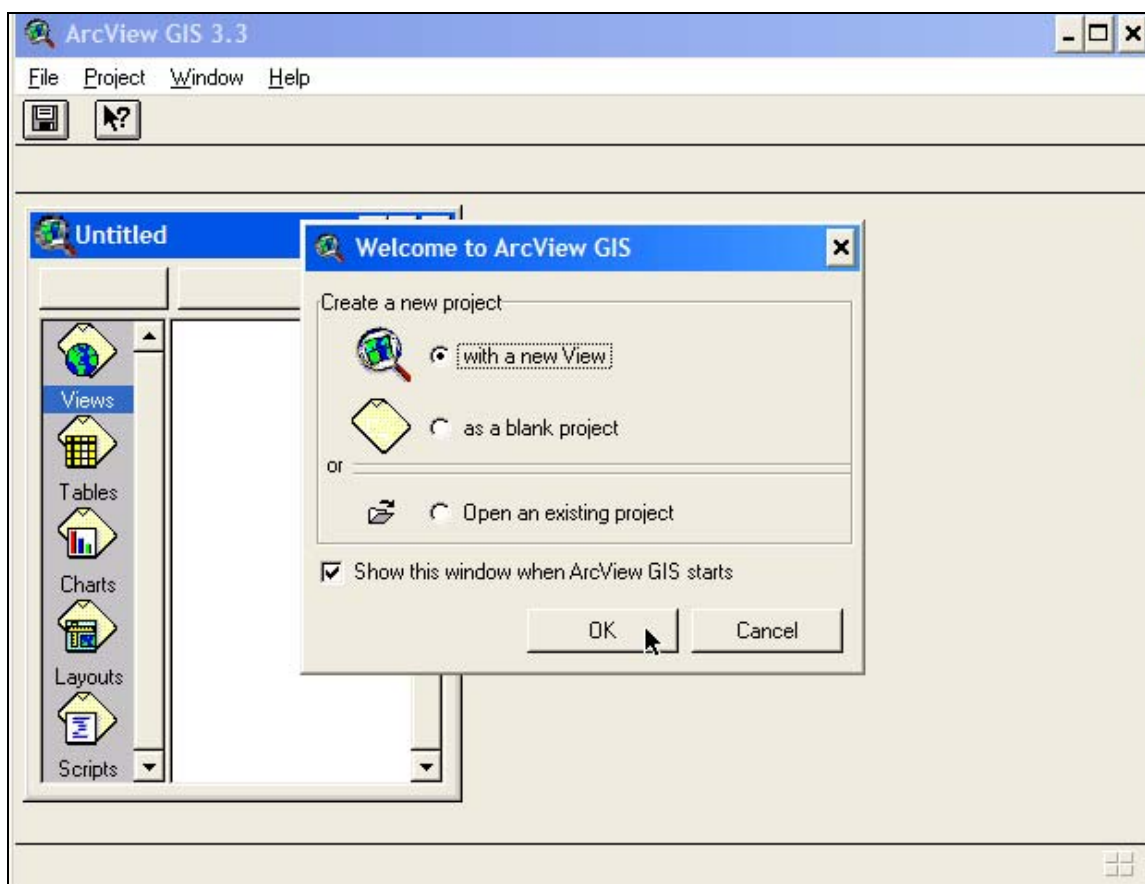


2. Open ArcView from the desktop shortcut.

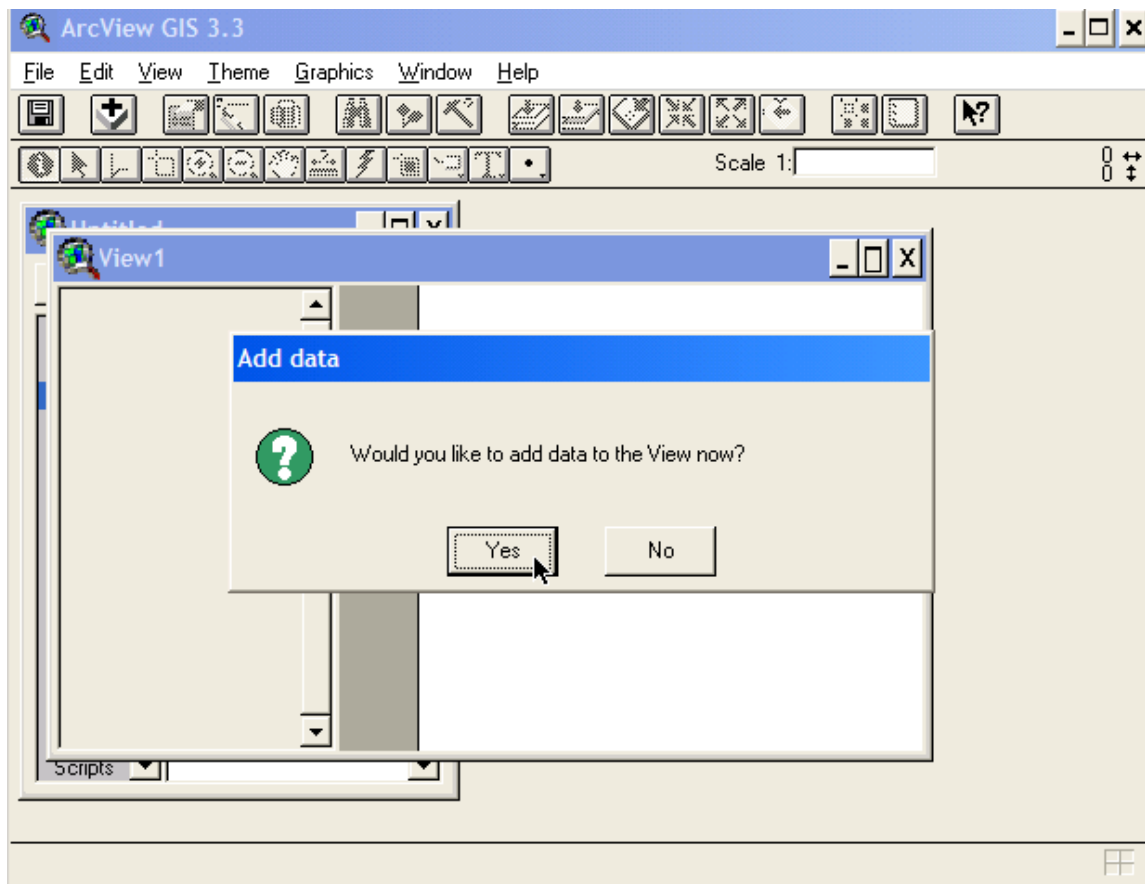
Click on the shortcut icon to start ArcView.



The Welcome to ArcView dialog box presents the user with three choices. Select **Create a new project with a new View**. Click OK.

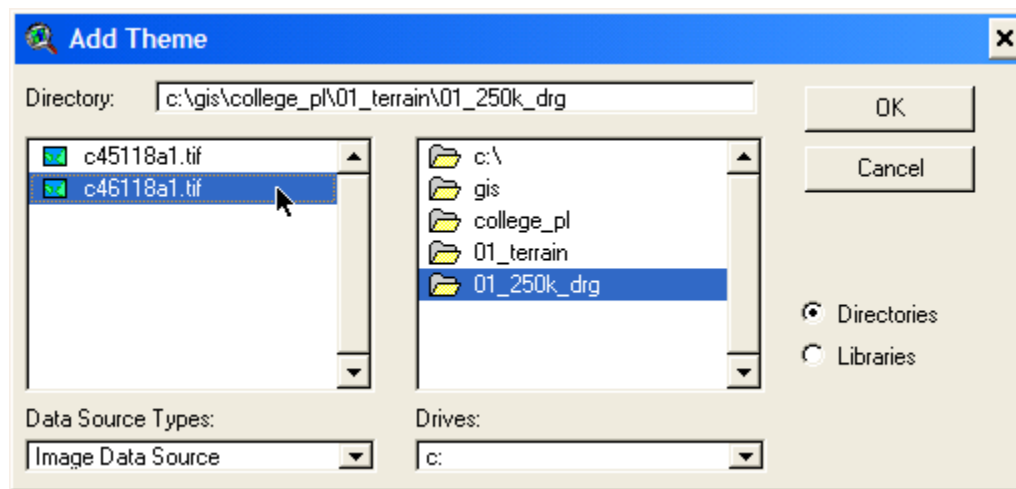


Click Yes in the Add data dialog box.

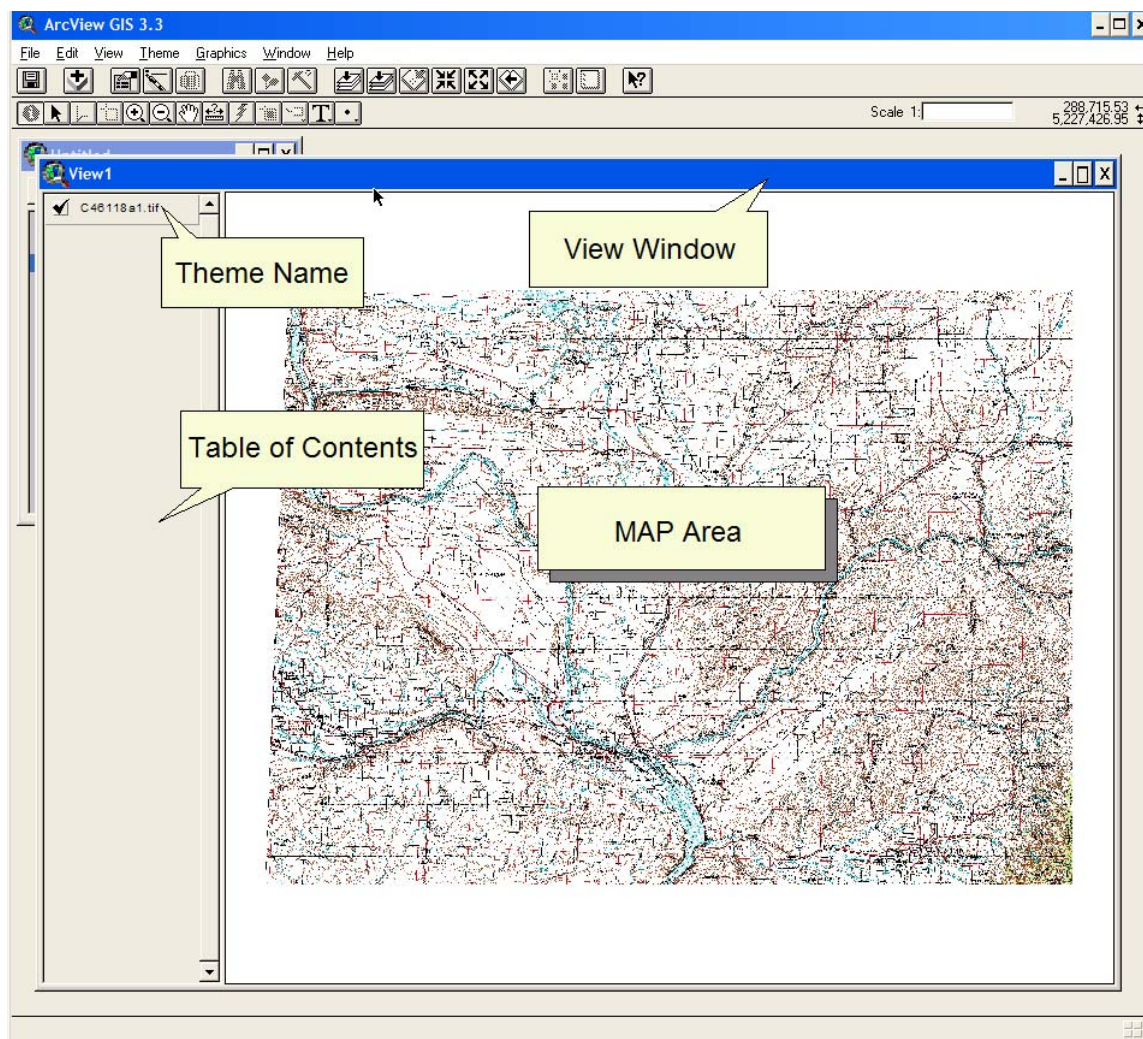


3. Load a 250K Digital Raster Graphic

Change the Data Source Type to **Image Data Source**. Navigate to the directory: C:\GIS\College_pl\01_Terrain\01_250K_DRG. Select the file c46118a1.tif. Click OK.



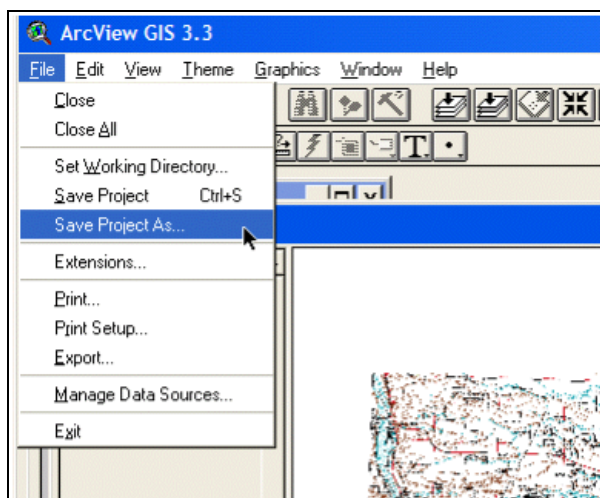
Click the check box on the theme (data layer) name in the view window table of contents to make the theme visible. See the image below to identify the various parts of the image.



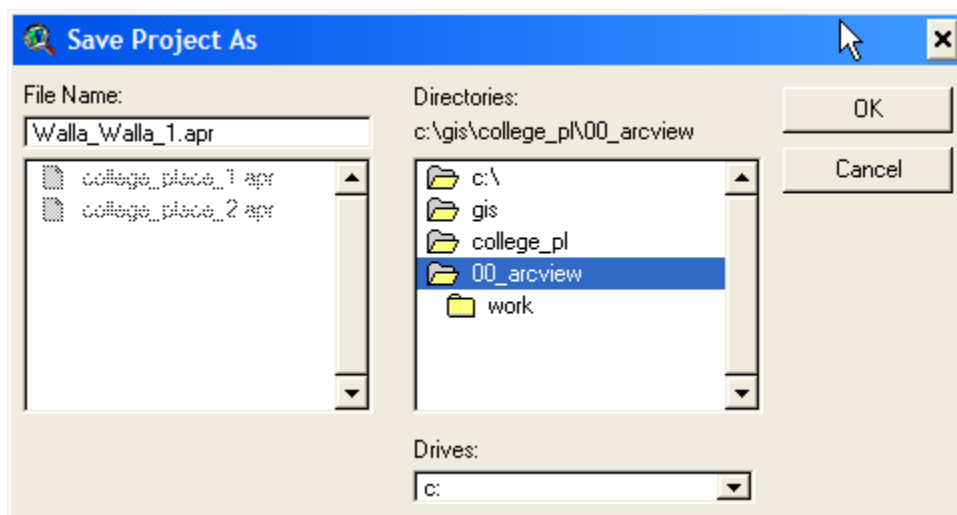
The map image is a scanned version of the 1:250,000 scale topographic map produced by the U.S. Geological Survey. Scanned topographic maps of all scales are called Digital Raster Graphics (DRG). DRG's in scales of 1:250,000 (250K), 1:100,000 (100K), 1:24,000 (24K) scales are available for most areas of the U.S. As we just saw, DRG's are georeferenced so they may be loaded as image themes into GIS software.

4. Save the ArcView project.

Select **Save Project As** under the File menu.

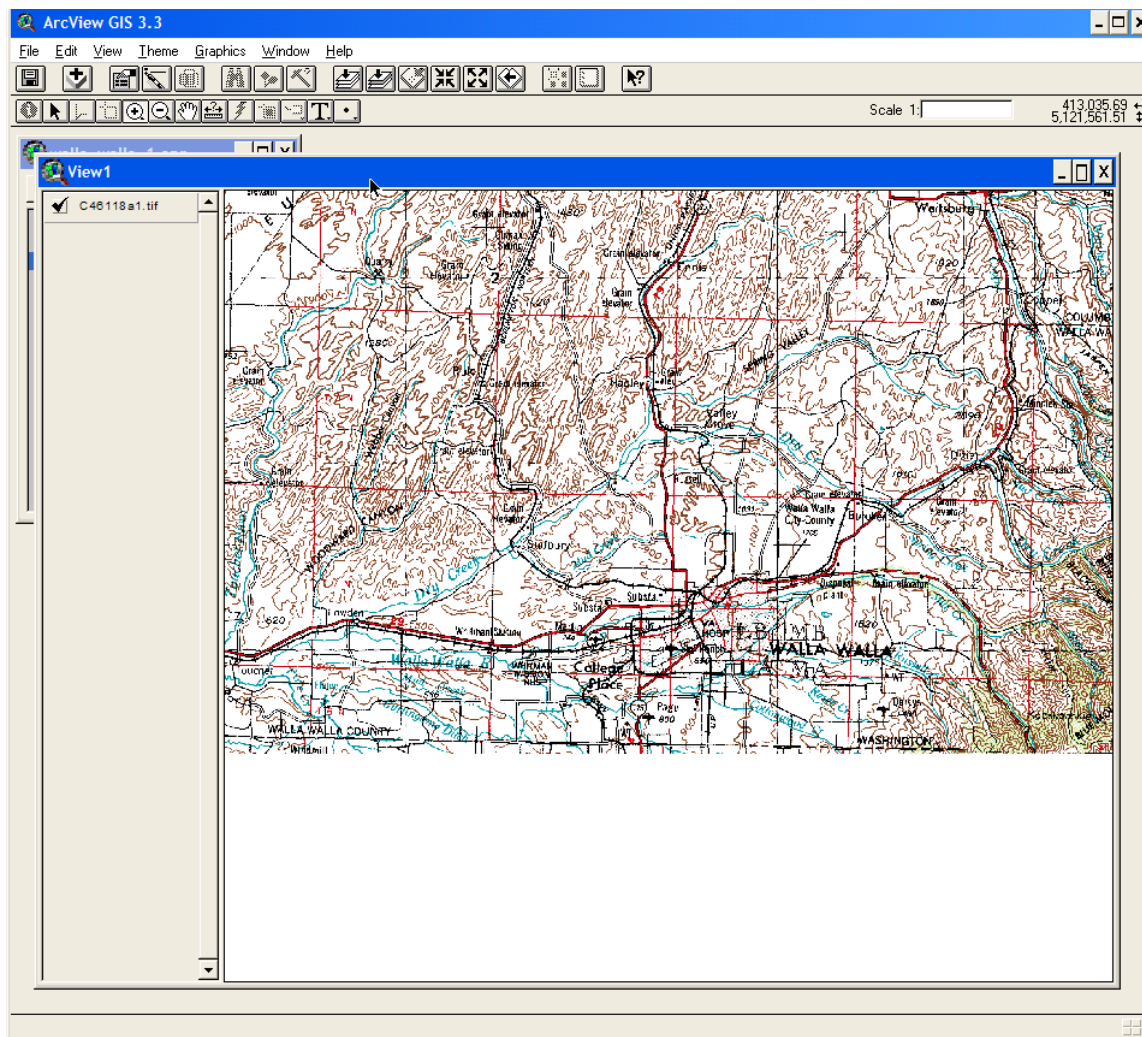


Navigate to a convenient directory, name and save the project. ArcView 3.3 project files have a *.apr extension. The ArcView project files does not have to be saved with a project's data files. The project file contain a listings of the data themes loaded into a project. We'll look at the structure of the *.apr file later. Click OK to return to the main view window.



5. Explore the 250K DRG


Use the zoom tool  to zoom to the area near the City of Walla Walla.

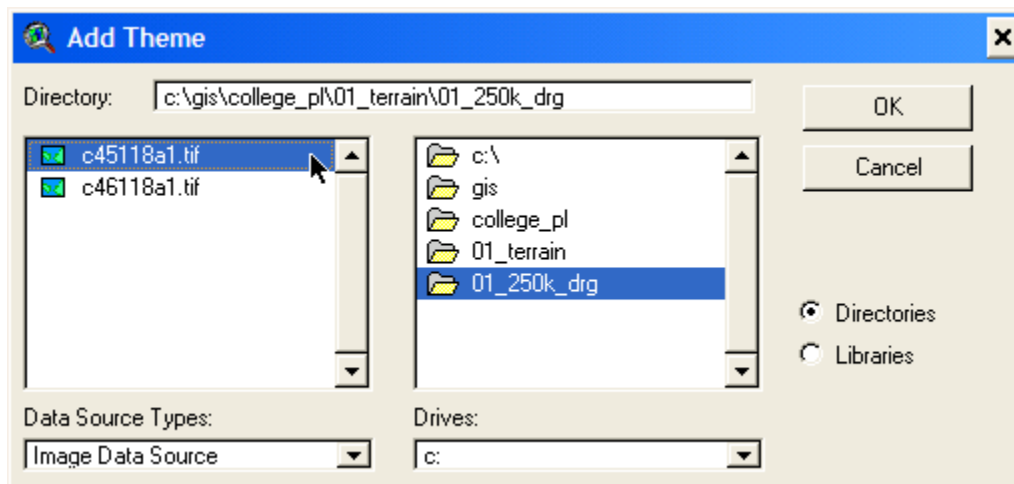


The level of topographic detail in the 250K DRG is good for observing features over larger areas. This particular DRG shows just the map area of the original paper map. The map legend, scale bars, and text information in the collar region has been “clipped” to allow easy viewing of adjacent map sheets.

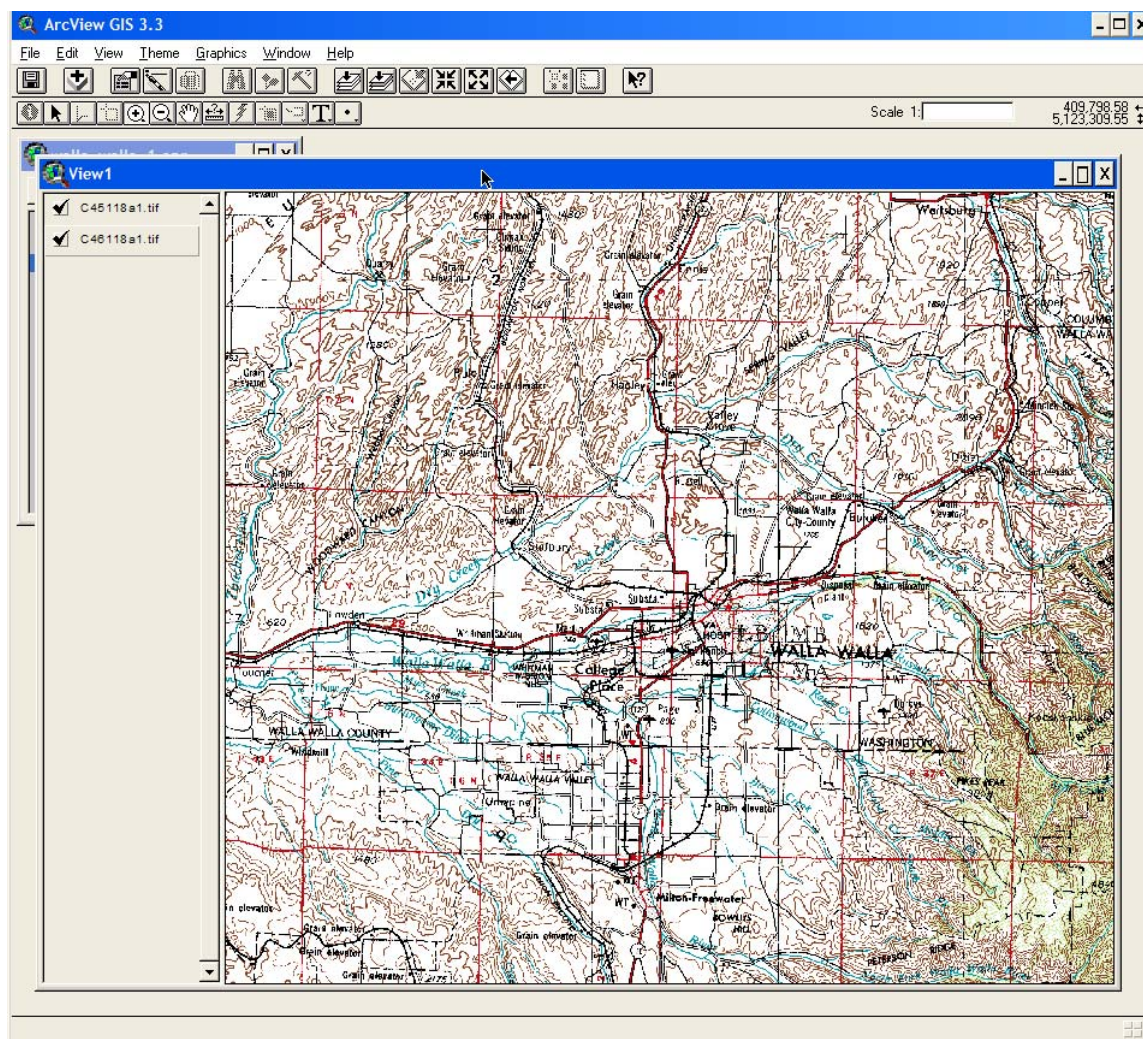
Explore the limits of the DRG coverage by using the zoom and pan tools.

6. Load the Neighboring 250K DRG

Click the add theme icon , navigate to the directory C:\GIS\College_pl\01_Terrain\01_250K_DRG and select the DRG theme c45118a1.tif.



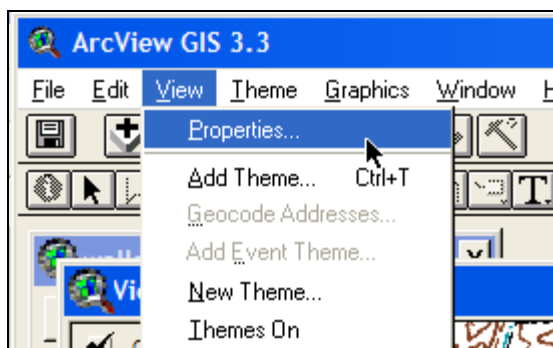
Make the new DRG theme visible. This DRG is located to the south of the first DRG. The DRG's are edge matched to provide a seamless view of the area covered by both DRG's.



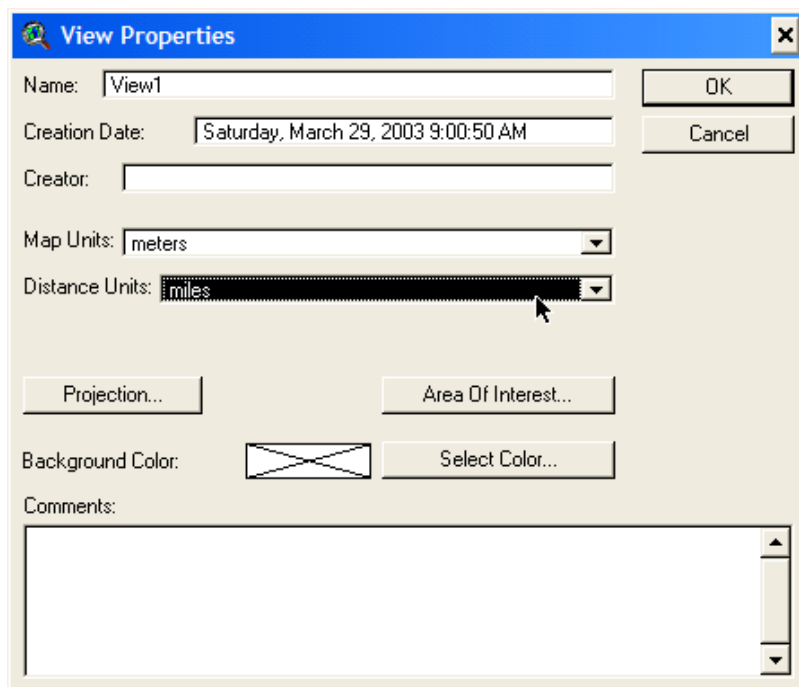
GIS software applications display georeferenced DRG's as a projected map. Georeferenced images come with map projection information that tells the GIS how to relate the position of each pixel in the image to its corresponding real world coordinates. Once a GIS loads a georeferenced image, a user can observe the geographic coordinates of any point in the image and make measurements of distance and area.

7. Set the View Properties

Select Properties under the View menu.

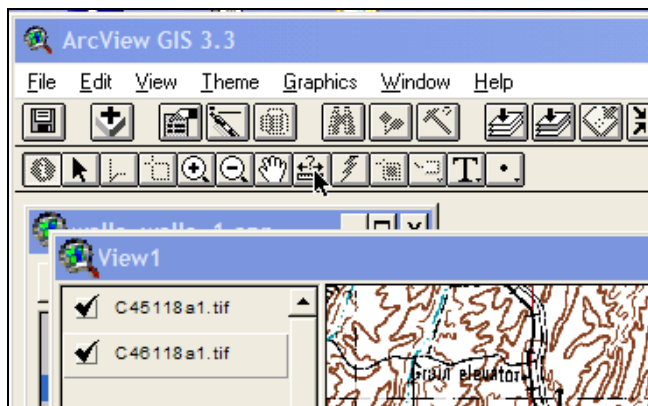



Options in the View Properties dialog can be set to define the units associated with the numeric coordinates of the projection. Most DRG's are projected according to the metric based Universal Transverse Mercator (UTM) system so the units are meters. Select meters in the Map Units pull down menu. Distance Units are set by the user and control the output of measurements made in the GIS view. Select miles in the pull down menu of Distance Units dialog. Click OK to return to the view window.

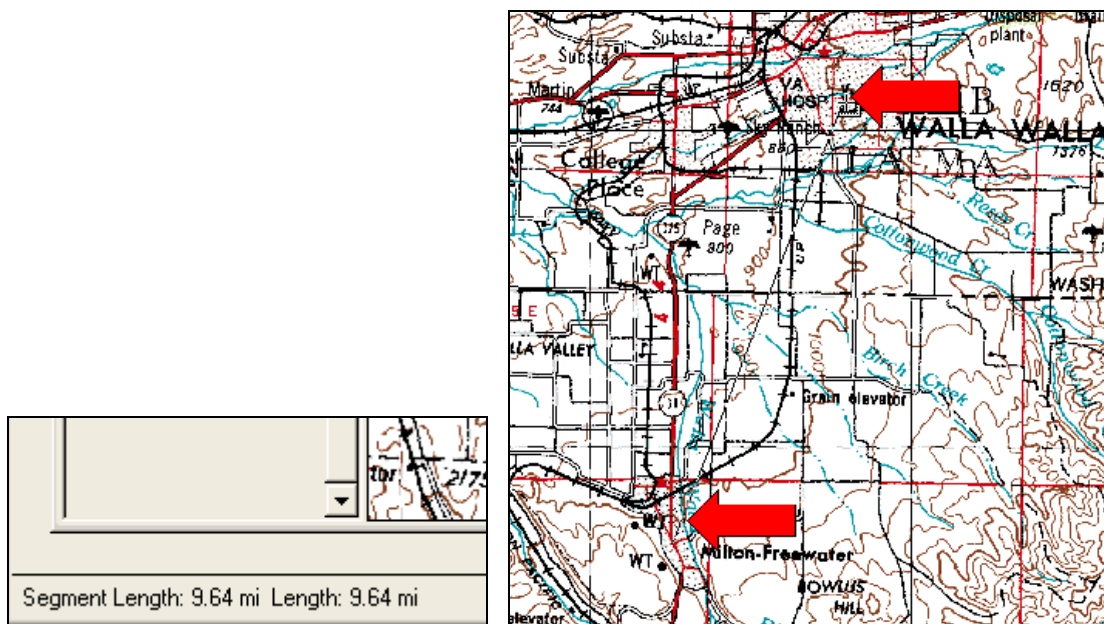


8. Measure a distance



Select the measure tool icon  in the main view menu.

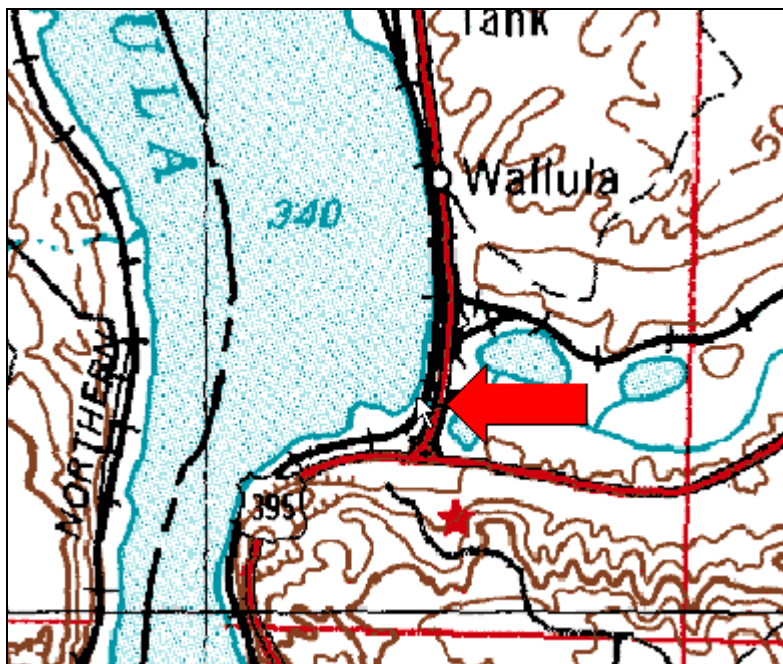


The pointer changes to . Move the pointer to the City of Milton Freewater and left click the mouse. This sets one end of the measure line. Move the pointer to the City of Walla Walla. A line extends from the first point and follows the pointer. Left click again to set the end point of the measurement line. Length is reported in the lower left end of the message bar at the bottom of the view window.



9. Determine Coordinates a Point

Select the pan tool  and move along the Walla Walla River to the confluence with the Columbia River. Select the pointer tool  and position it over the point where the Walla Walla River meets the edge of the Columbia River.



The coordinates of the pointer are given in the right end of the message bar at the top end of the view window.

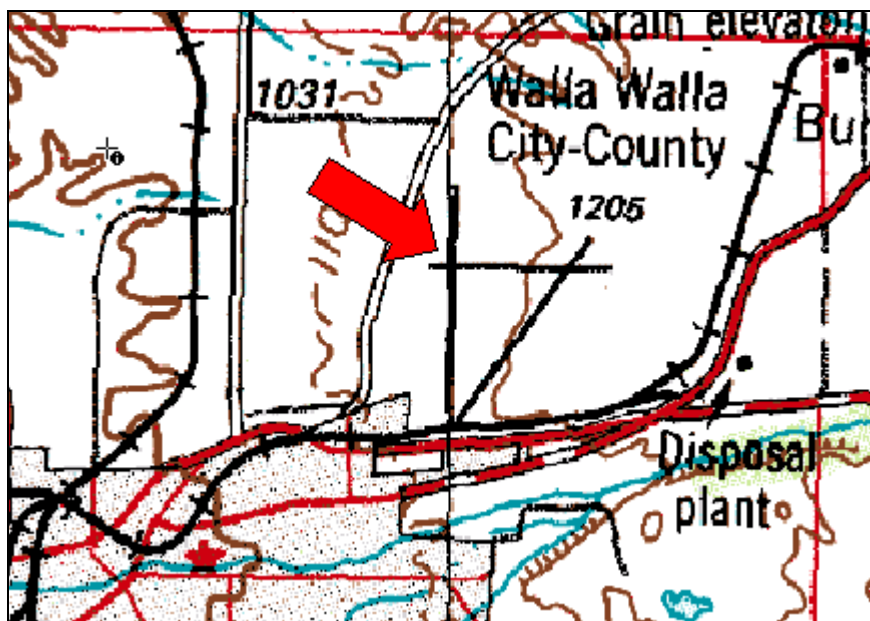
Scale 1:88,757	352,412.09 ↔
	5,102,458.25 ↕

The reported easting coordinate is 352,412.09 and the northing coordinate is 5,102,458.25. The coordinates are reported to much higher accuracy than warranted by the scale of the DRG. For formal reports, always round reported coordinates to an appropriate level of precision, probably the nearest 100 meters in this case. The scale number to the left of the coordinates is the reference scale for the GIS window.

1.

Exercise

- a. Locate the Walla Walla City County Airport. What are the UTM coordinates of the intersections of the runways indicated in the figure below.
- b. What are the dimensional units of the coordinates?

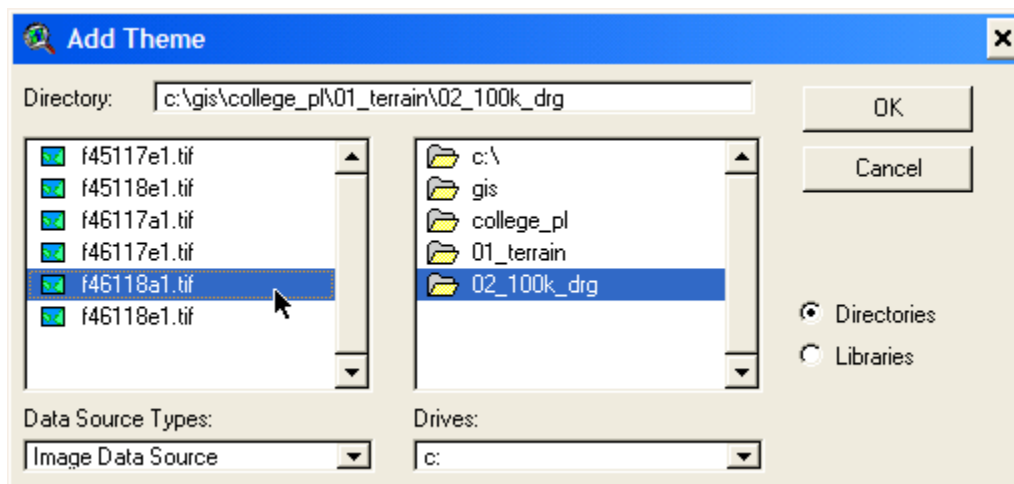


Answer: _____ E _____ N

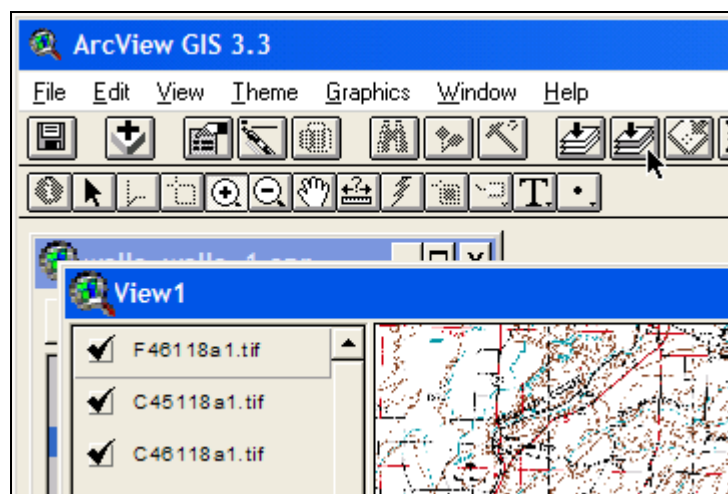
(Answer given at the end of the tutorial.)

To keep the exercise answers handy, print the answer page or open a second document window positioned at the answer page.

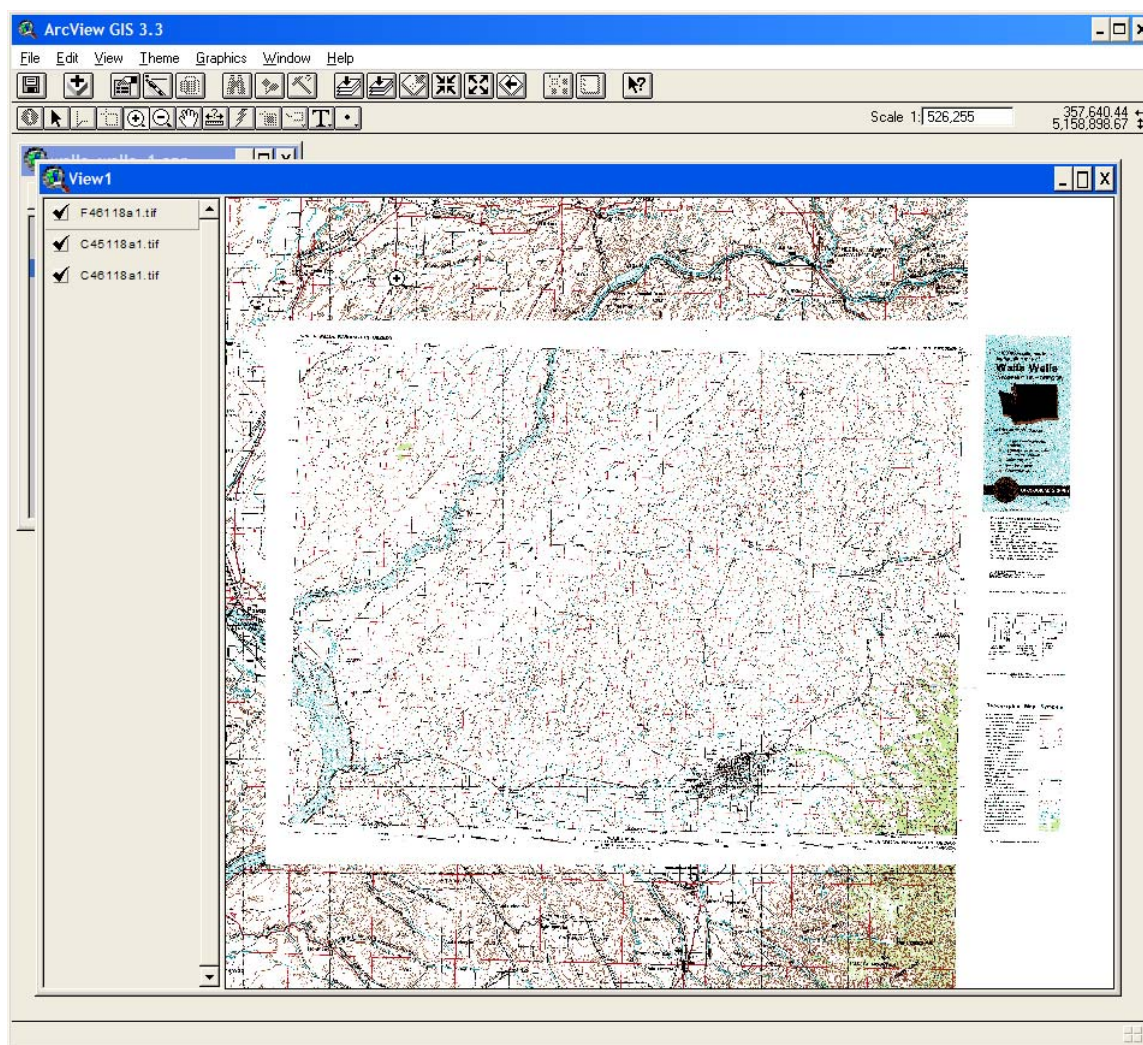
10. Load and Explore a 100K DRG



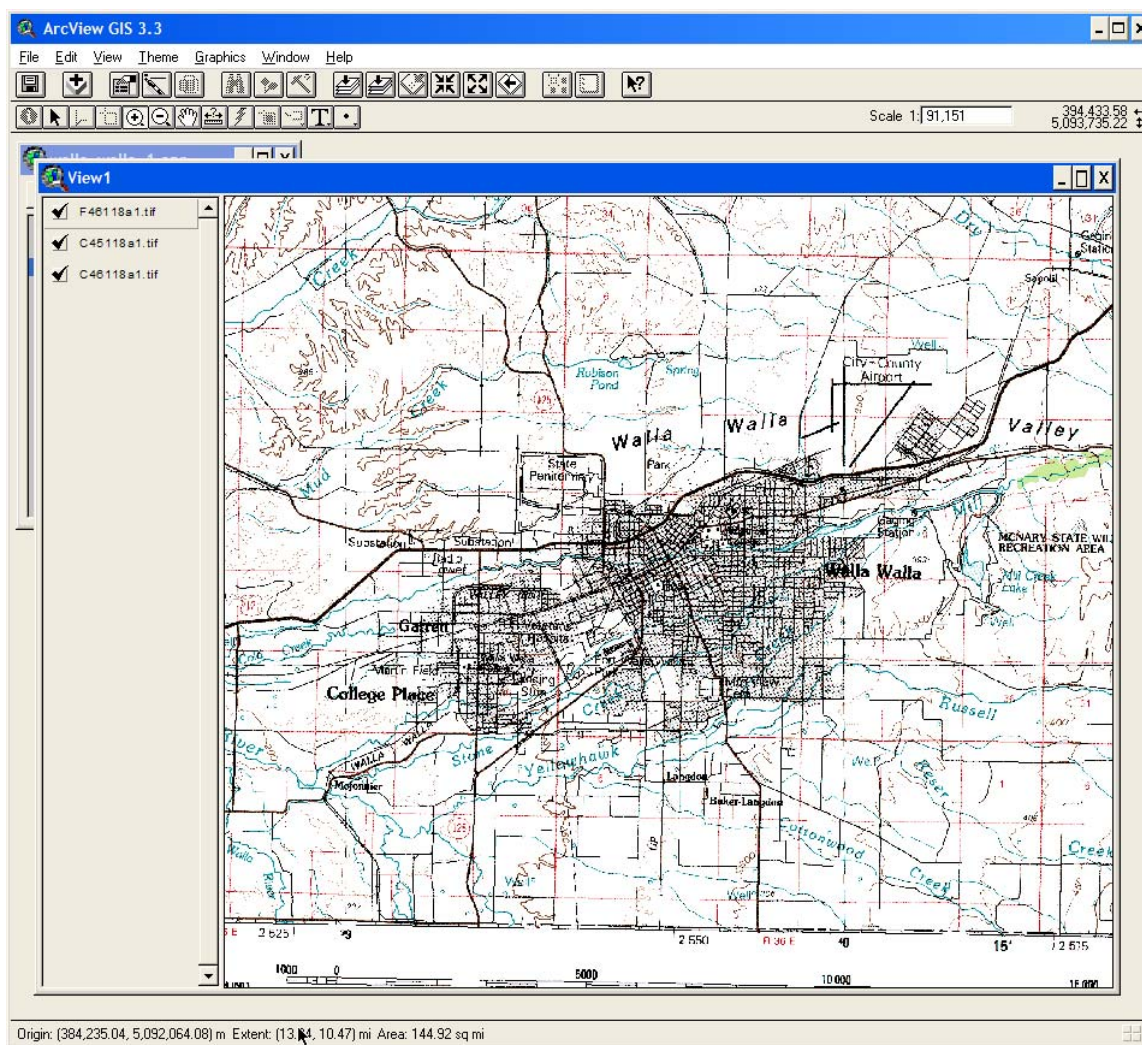
Activate (highlight) the new theme and click the zoom to layer  button.



The 100K DRG is a scanned image of the USGS 1:100,000 topographic map. It is higher resolution and provides more topographic detail than the 250K DRG, but it covers a much smaller area. This 100K DRG has not been clipped so all the original map collar information is visible.



Zoom to the City of Walla Walla area. More features are named and indicated by symbol on the 100K DRG than on the 250K DRG.



The screenshot shows the ArcView GIS 3.3 application window. The title bar reads "ArcView GIS 3.3". The menu bar includes "File", "Edit", "View", "Theme", "Graphics", "Window", and "Help". The toolbar contains various icons for map navigation and editing. The status bar at the bottom displays the following information:

- Origin: (384,235.04, 5,092,064.08) m
- Extent: (13.84, 10.47) mi
- Area: 144.92 sq mi

The main map window, titled "View1", displays a map of Walla Walla, WA. The map shows topographic features, roads, and infrastructure. Key labels on the map include "Walla Walla City-County", "Grain elevator", "Disposal plant", "College Place", "Page 800", and "Walla Walla". The map is overlaid with a red line network. The left sidebar shows a list of data sources:

- F46118a1.tif
- C45118a1.tif
- C46118a1.tif

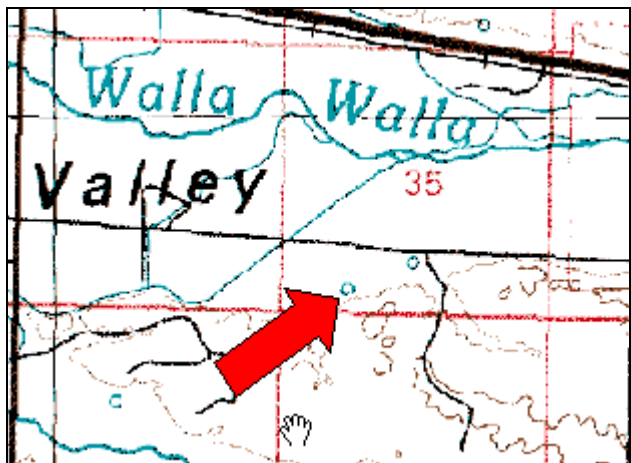
2.



Exercise

- a. What are three rivers or creeks named on the 100K DRG in the vicinity of the City of Walla Walla?

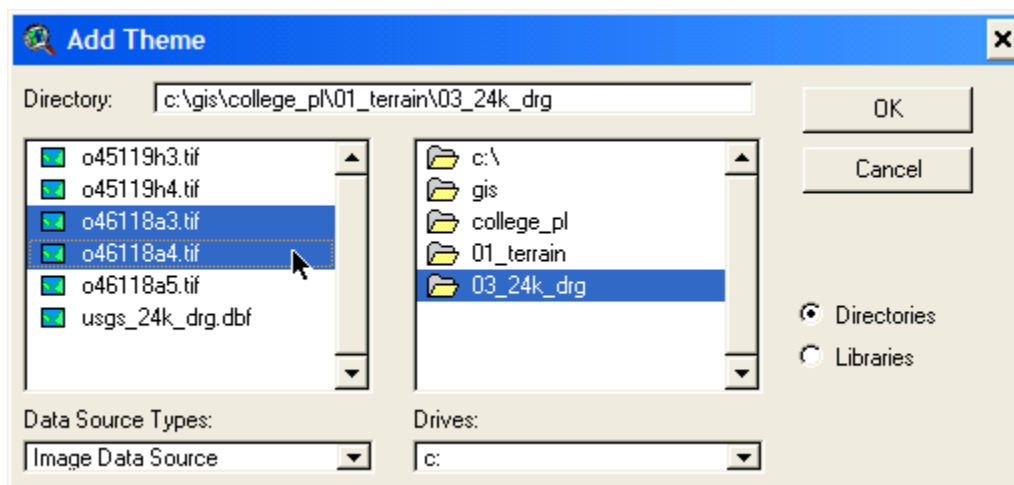
- b. What features are indicated by the light blue circles in the figure below? Hint: Examine the map symbol legend in the map collar.



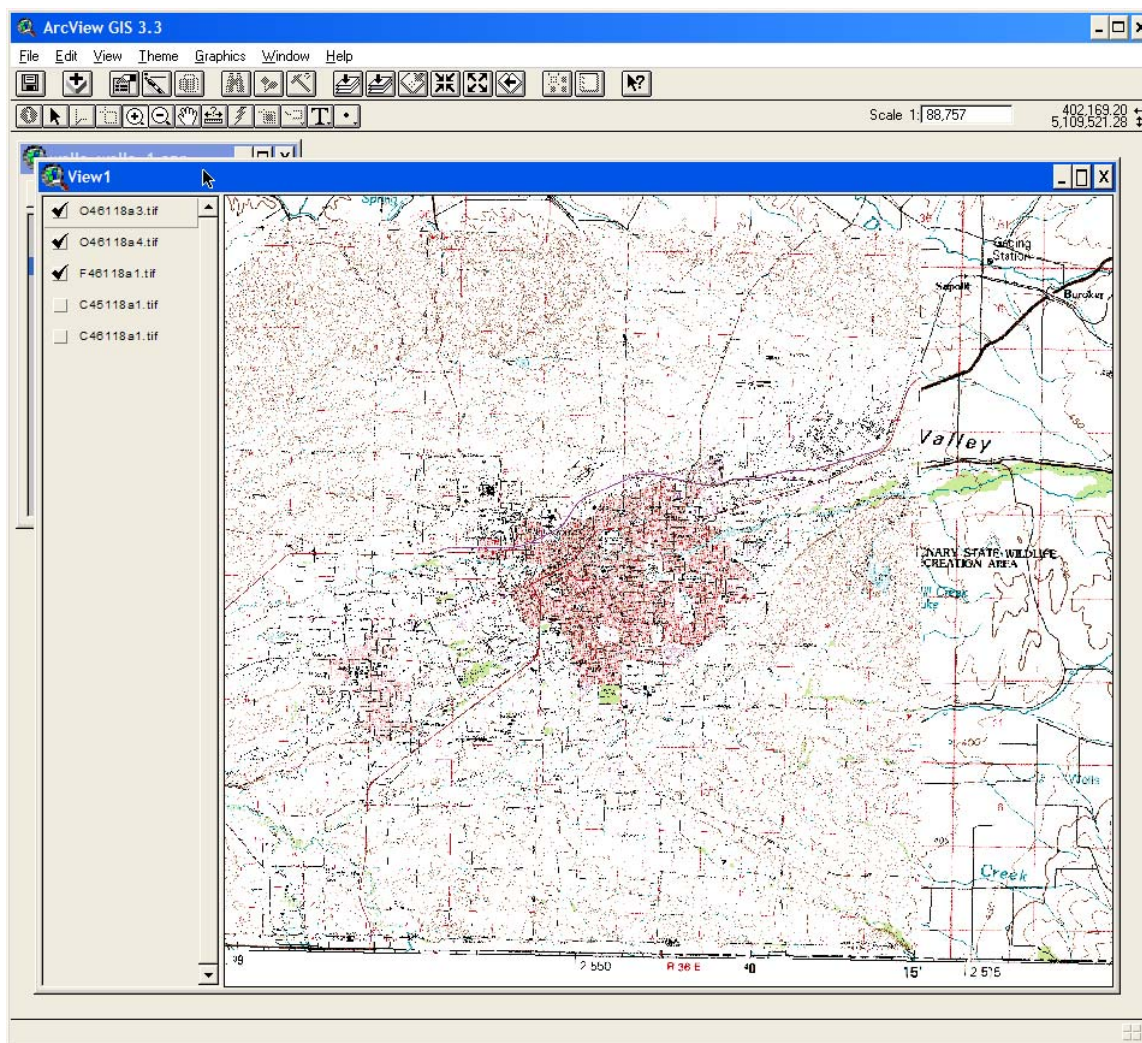
- c. What is the publication date of the original map of 100 DRG? What was the date of the last photorevision?

11. Load and Explore a 24K DRG

Click the Add Theme icon. Navigate to the directory C:\GIS\College_pl\01_Terrain\03_24K_DRG. Hold down the shift key and select the two 24K DRG's shown below.



Activate the theme O46118a3.tif and click the Zoom to Layer button.



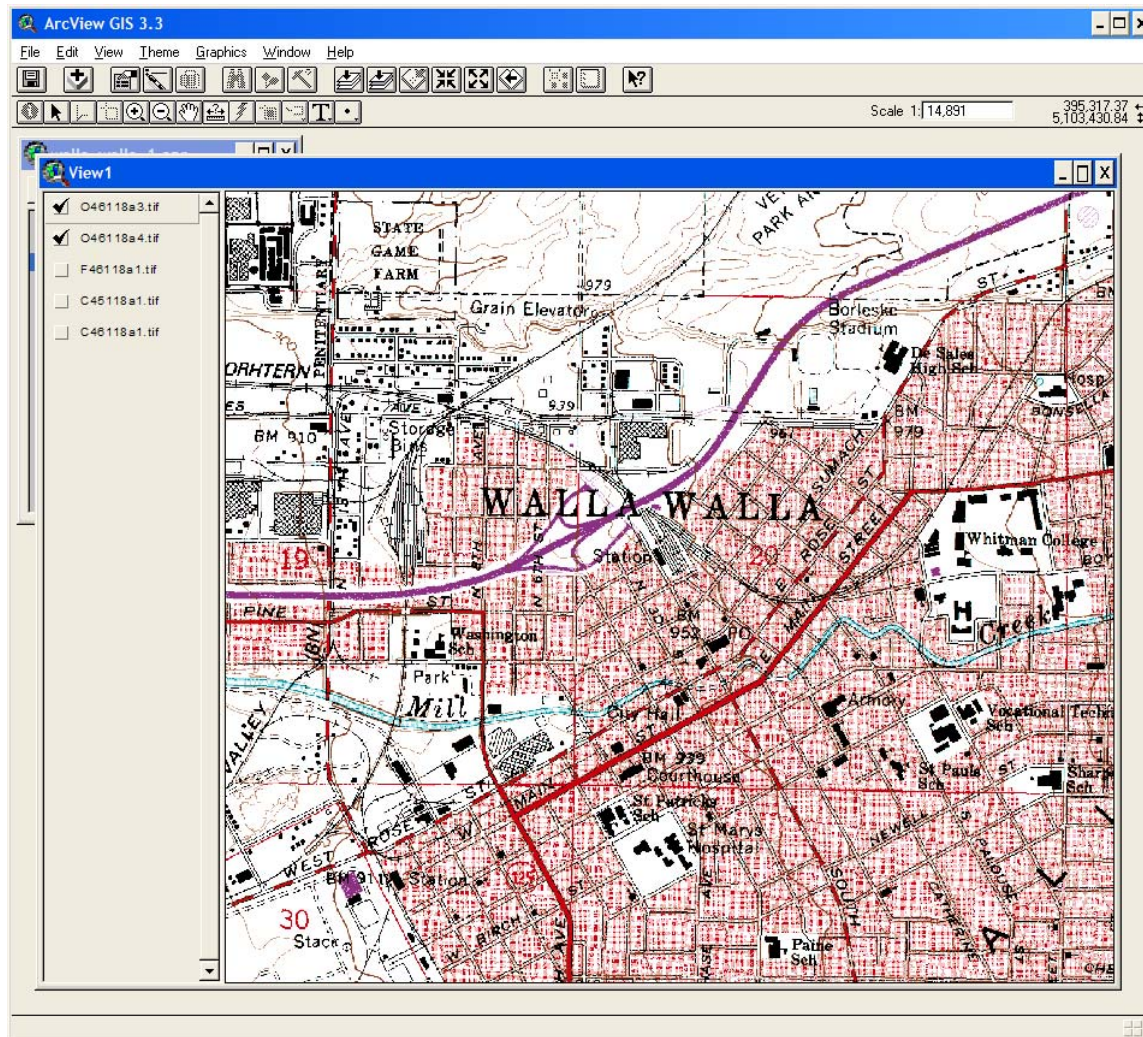
The USGS 24K DRG is the highest resolution (largest scale) topographic DRG routinely produced by USGS. It provides the highest level of detail. Features seen in 24K DRG's are usually interpreted and delineated directly from aerial photographs. The 24K DRG or its original 1:24,000 7.5 minute topographic quadrangle, often serve as primary base maps for other USGS map products. The 24K DRG's are an important source of historic land cover information. Use and interpretation of USGS 24K DRG's are discussed in a separate tutorial.

SAVE the project.

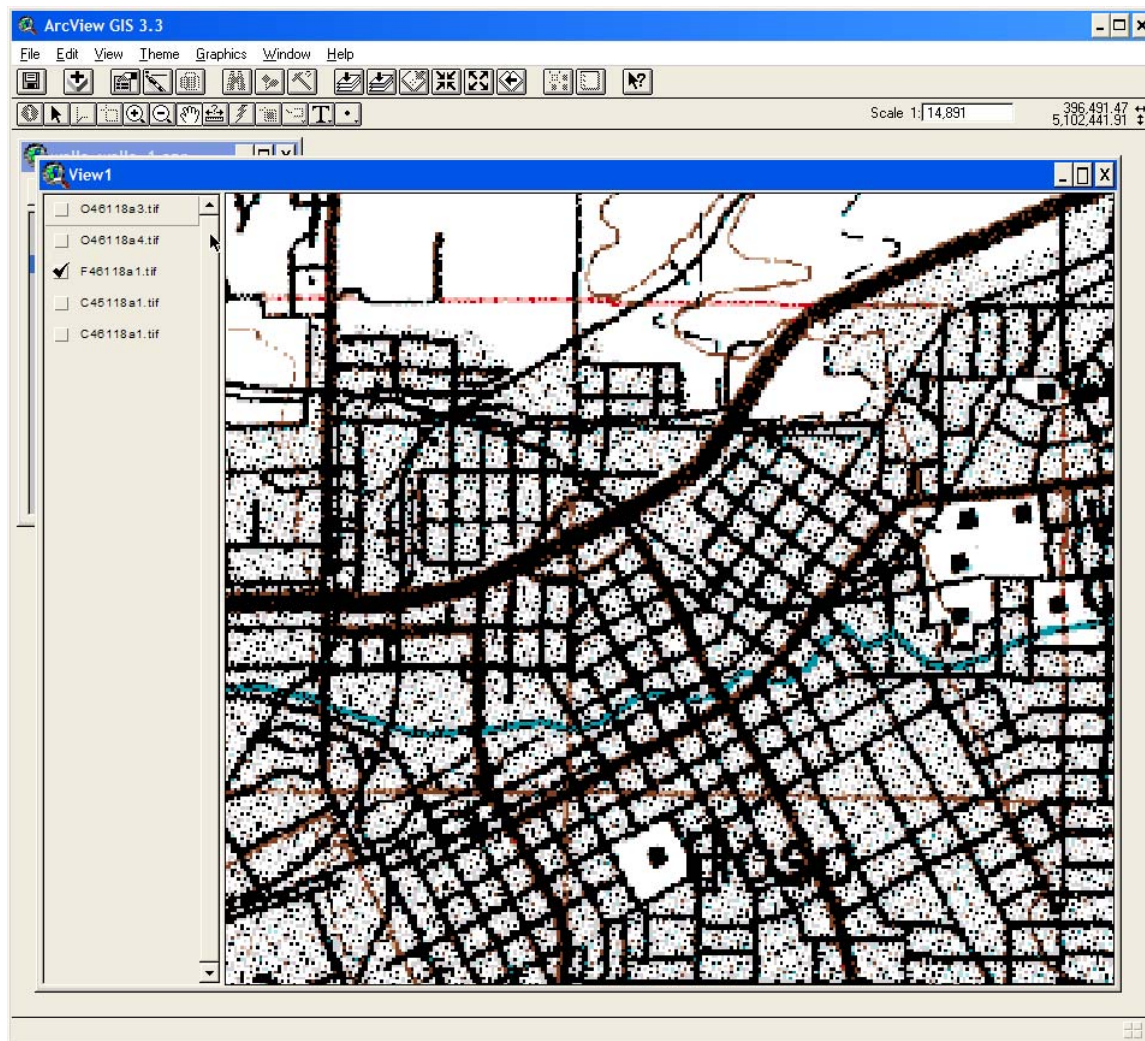
© Teasdale Environmental Associates, PLLC

12. Compare Detail of Different Scale DRG's

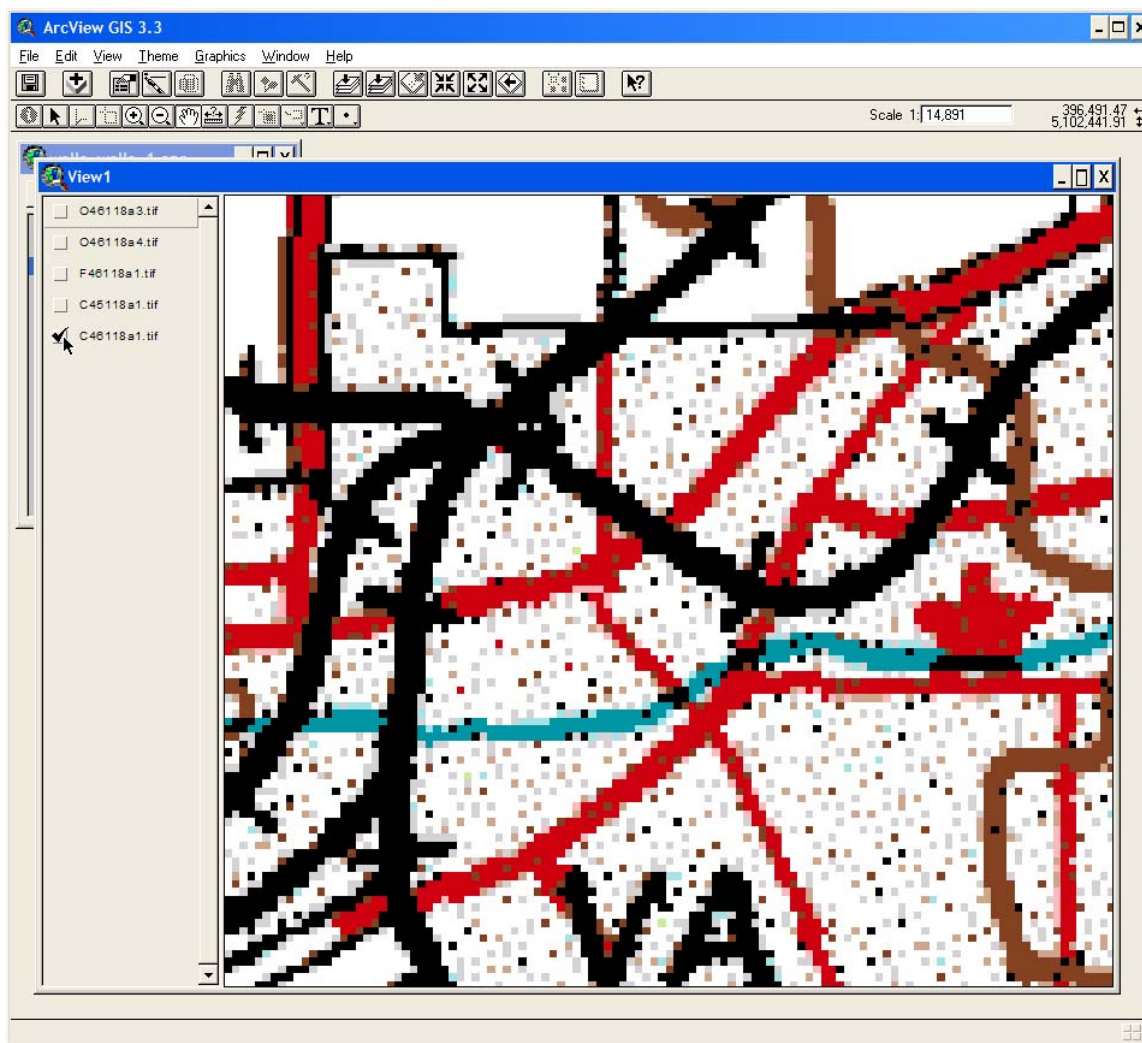
A quick visual comparison of the different scale DRG's helps emphasize their differences. Zoom to a City of Walla Walla that shows Mill Creek and the US HW 2 interchange.



Turn off the 24K DRG's and turn on the 100K DRG.



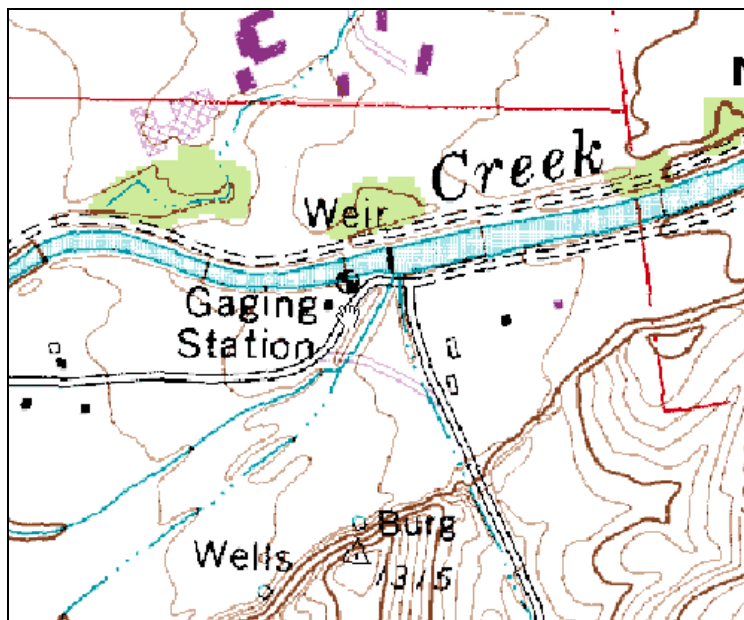
Turn off the 100K DRG and turn on the 250K DRG.



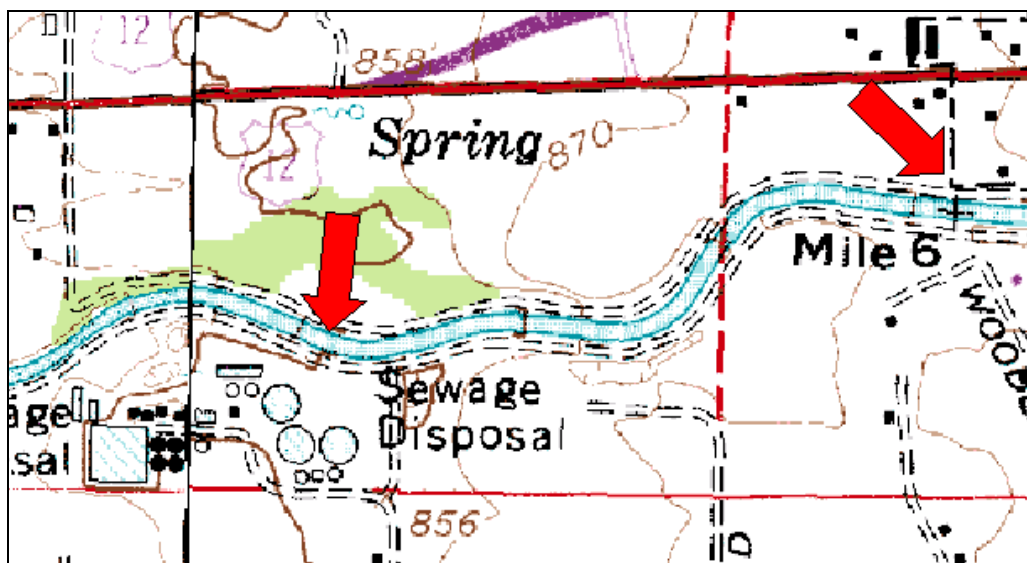
This comparison emphasizes the difference between the scales of the DRG's. Note that the alignments of Mill Creek and the roadways at the three scales agree fairly well. This is because all the DRG's are projected to a common projection. In this case the projection is the Universal Transverse Mercator Zone 11 North based on the North American Datum of 1927. This projection is often identified by the abbreviation UTM11 NAD27. There are several UTM zones across the U.S. The Pacific Northwest lies mostly in UTM 10 and UTM 11. The UTM zone 10 is west of UTM zone 11. Another common projection for DRG's is the Universal Transverse Mercator based on the North American Datum of 1983 (UTM NAD83).

13. Features in 24K DRG's

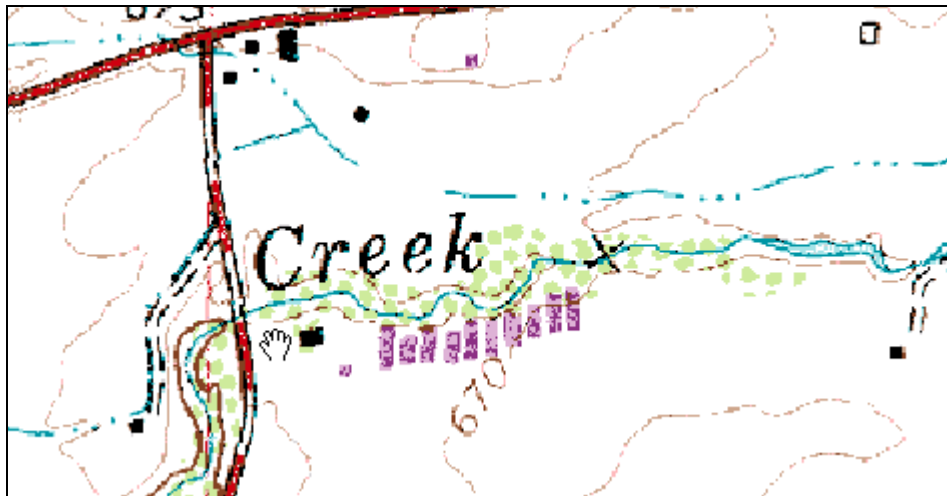
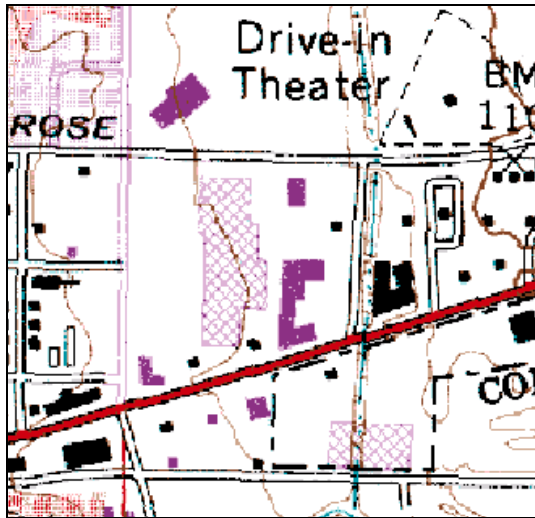
Many hydrographic features are depicted on 24K DRG's. The locations of features such as stream flow gaging stations, weirs, wells and wastewater discharges are identified by symbols and text.



River mile markers on major streams and rivers show the distance upstream from the mouth of the stream as defined by the regional navigation authority or U.S. Army Corps of Engineers.




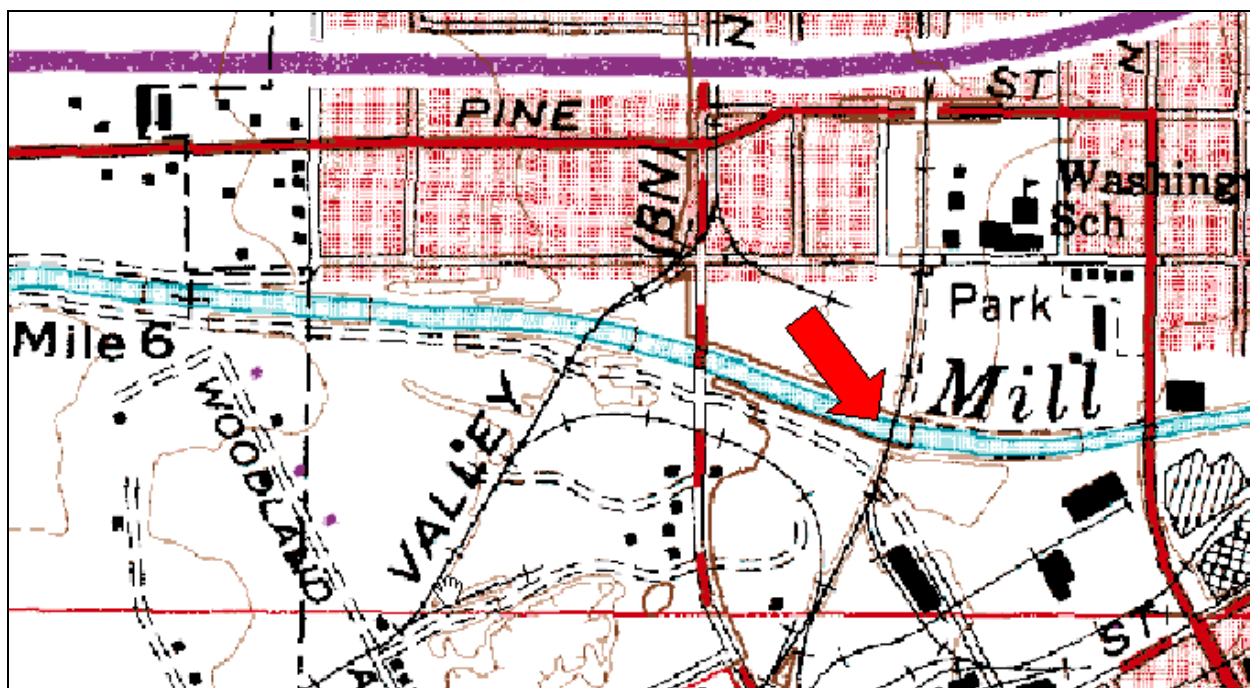
Some data in the 24K DRG's, such as elevation contour lines, do not normally change. Other data such as limits of residential land use in urban areas and stream centerlines in highly active alluvial flood plains may change often. USGS periodically revises the 24K topographic maps to document changes, but an extensive photorevision may not have been performed for 20 or 30 years. Features added during the last photorevision are shown in a magenta color. The date of the last photorevision is stated in the map collar.



3.

Exercise

Using the distance tool , determine the approximate river mile to the nearest 0.1 mile of the rail road bridge that crosses Mill Creek in the western part of the City of Walla Walla. Hint: set the View units to miles.



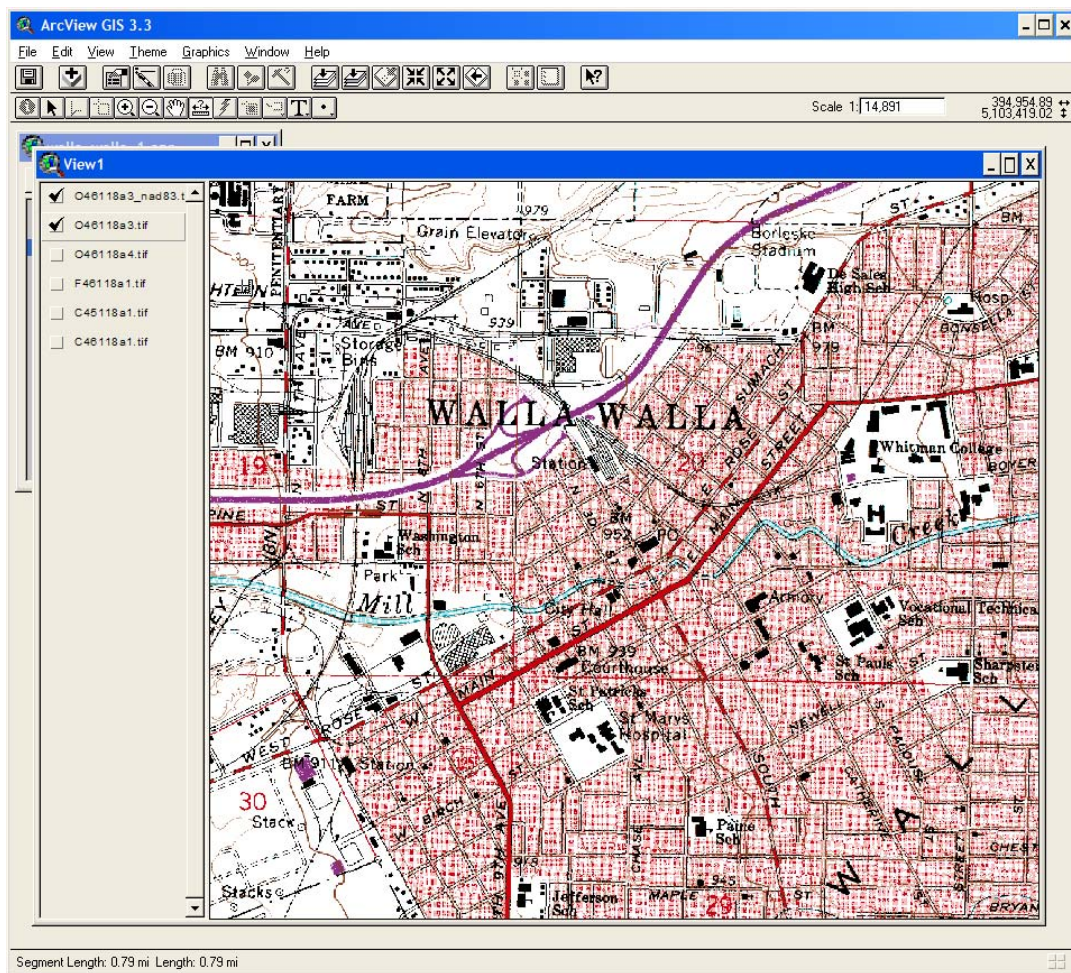
Answer:

_____ miles

14. A Comparison of DRG Projections


DRG users should be aware of the positional difference between UTM NAD27 and UTM NAD83. Mismatching themes with these similar, but different projects can lead to erroneous GIS measurements. Another tutorial provides more detail on map projections, but a quick comparison can be made to indicate the difference.

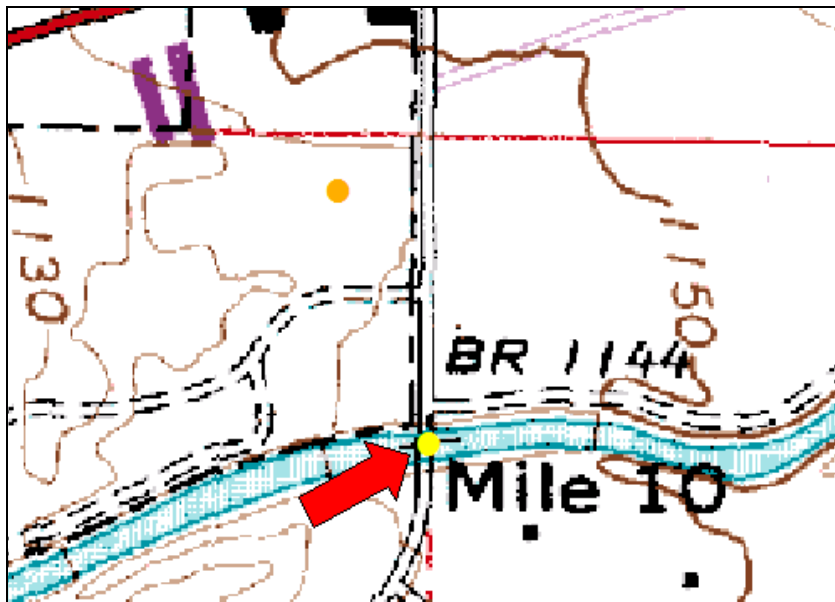
A copy of the 24K DRG o46118a3.tif called o46118a3_nad83.tif is located in the directory for the 24K DRG's. This new DRG is projected to the UTM 11 NAD83. Load it and turn it on. Also turn on the original NAD27 version. Toggle the NAD83 DRG on and off to compare the locations of features such as the highway interchange.



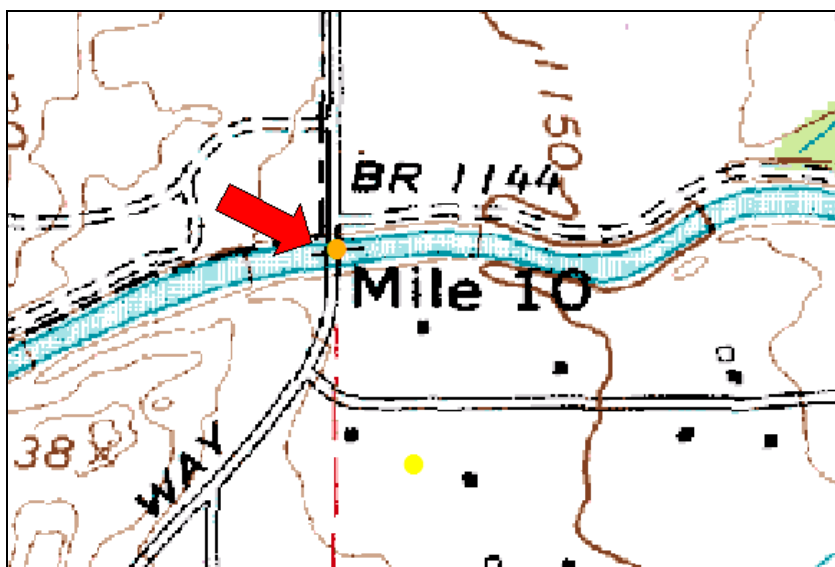
Exercise

Determine the offset distance between the same points on the NAD27 24K DRG and the NAD83 24K DRG.

Hint: Use the graphics tool to set a point  on the same feature in both projections. Use the measure tool to measure the offset. Set the view units to meters.



UTM 11 NAD27



S U M M A R Y In this tutorial we have seen how to create a basic GIS project and use some of the GIS tools included with the ArcView 3.3 software. We developed our initial GIS project with Digital Topographic Maps (DRG's) produced by USGS. We compared the content and spatial characteristics of the various DRG's and practiced identifying and locating topographic features. The fundamental skills learned in this tutorial provide a background for further work with georeferenced aerial and satellite imagery.

Answers to Exercises

1. Answer :

- a. 400,000 meters E, 5,105,600 meters N
- b. meters

2. Answer:

- a. Mill Creek
Walla Walla River
Stone Creek
- b. Water well



Windmill; water well; spring

- c. 1980, 1976

Produced by the United States Geological Survey

Compiled from USGS 1:24 000-scale topographic maps dated 1963–1978. Planimetry revised from aerial photographs taken 1976 and other source data. Revised information not field checked. Map edited 1980

Projection and 10 000-meter grid, zone 11,
Universal Transverse Mercator
25 000-foot grid ticks based on Washington coordinate system,
south zone. 1927 North American Datum

To place on the predicted North American Datum 1983
move the projection lines 18 meters north and 83 meters east

There may be private inholdings within the boundaries of
the National or State reservation shown on this map

3.

Answer:

The rail road bridge is 0.51 miles upstream from River Mile marker 6, so the rail road bridge is located at River Mile 6.5.

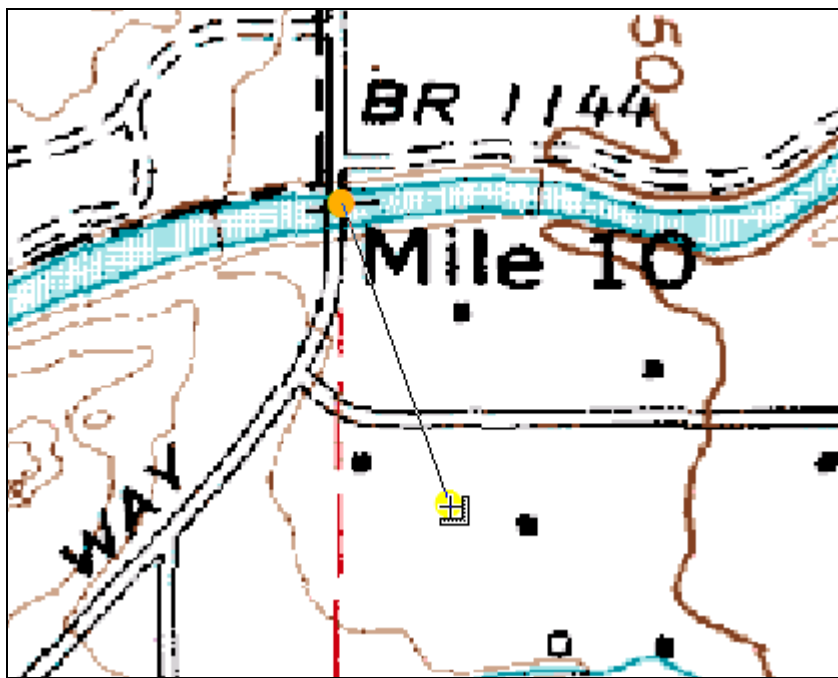
Determine the answer by selecting the distance tool and clicking a continuous line along the stream centerline from River Mile marker 6 to the railroad bridge. Read the total distance in the message bar at the bottom of the view window. Double click the distance tool to clear the continuous line.



Segment Length: 0.06 mi Length: 0.51 mi

4. Answer:

The offset distance is approximately 220 meters. A point on the UTM11 NAD83 projection lies about 220 meters northwest of the same point on the UTM11 NAD27 projection.



Segment Length: 220.99 m Length: 220.99 m
